

## Energy in Matter

### Process and Procedures

*Part A: Matter and Energy Interactions*

Date

Pages 413-415

Page #

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1. What is matter? Give three examples of matter.

2. What is energy? Give three examples of energy.

3. How are matter and energy related? Give at least one example.

4b. Record your observations.

4e. Describe the changes that occurred.

8a. Was the reaction exothermic or endothermic? Explain.

8c. Describe where the energy produced by the reaction originated and where it was transferred?

8e. Did any of the atoms of the chemicals involved disappear because of the reaction? explain.

# Chapter 8: The Cellular Basis of Activity

## Energy in Matter

### Matter and Energy Are Related

Date \_\_\_\_\_

Pages 415-419

Page \_\_\_\_\_

#### Atoms

basic building blocks of matter

Elements

made up of the same type of atom

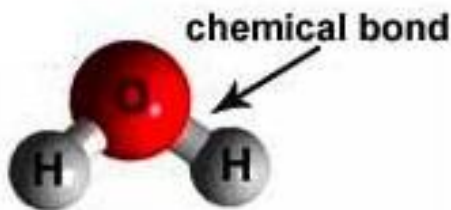
6 elements

make up 99% of the human body:

- carbon
- hydrogen
- oxygen
- nitrogen
- calcium
- phosphorus

#### Chemical bonds


hold atoms together to form molecules



Bonds are forces of attraction

Breaking bonds

requires energy

When bonds are formed and broken, the atoms are not affected  
 matter is conserved

Forms of energy

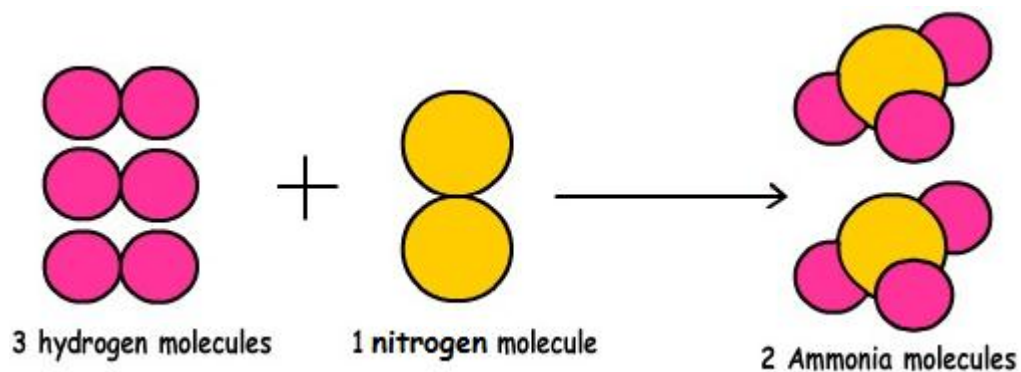
- chemical
- solar
- thermal
- nuclear
- electrical
- light


Energy can be transferred between any of these forms

 heat is released

Chemical reactions

rearrange atoms



 release OR take in heat energy

**Exothermic reaction**

chemical reaction that releases heat

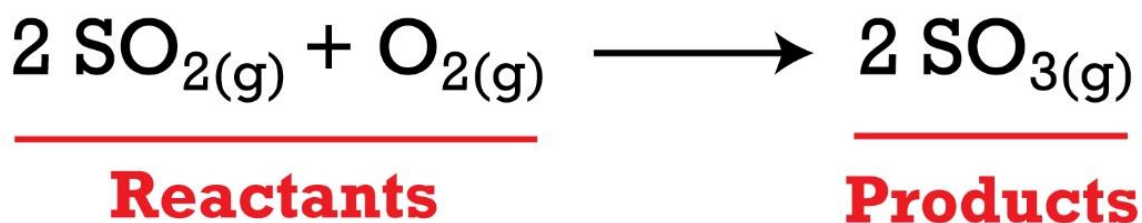
*Exo* = out

*Thermic* = heat

Energy is released when the atoms are rearranged to form new molecules

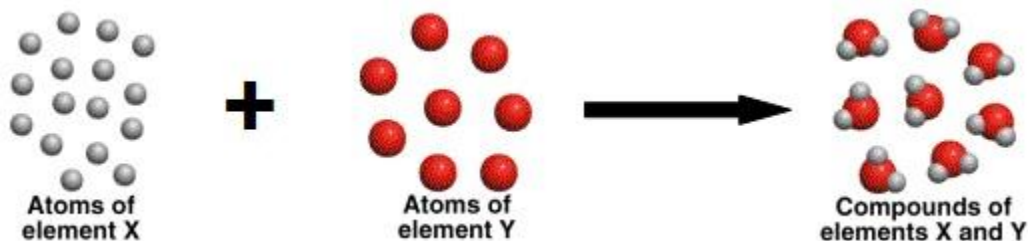
## Reactants

the molecules present at the beginning of a reaction



Chemical reactions

matter is not created or destroyed—it only changes form



## Endothermic reaction

a reaction that takes in heat energy from its surroundings

*Endo* = in

## Energy in Matter

### Energy is Converted and Conserved

Date

Pages 422-426

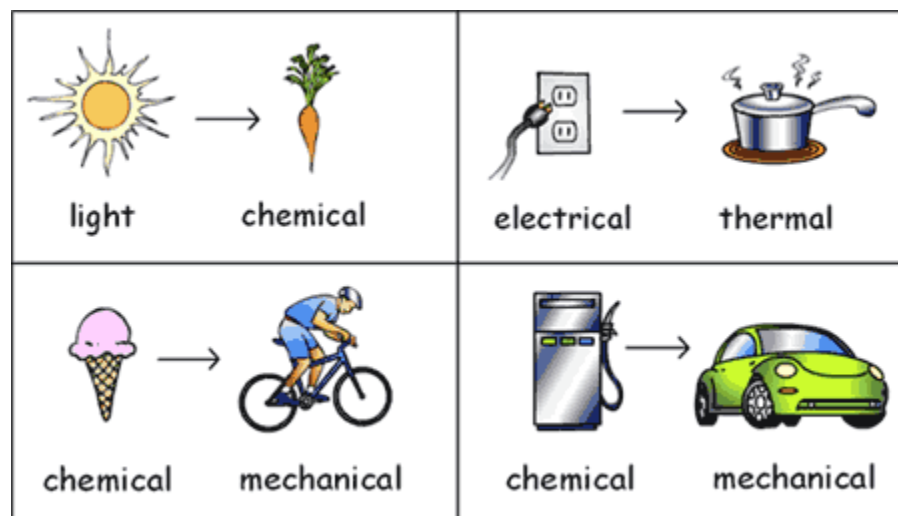
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Energy

can be converted from one form into another

Examples:

- electrical to thermal (turning on a stove)
- mechanical to electrical (hydroelectric dam)
- potential to kinetic



### Potential energy

stored energy an object has and is available for use (inactive)



## Kinetic energy

energy of objects in motion  
(active)



Potential to kinetic

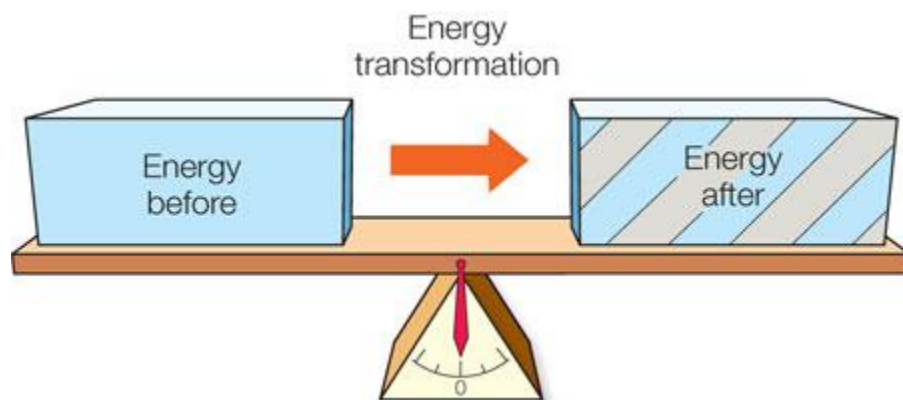
when potential energy is converted to kinetic energy, the kinetic energy:

- can be captured and made useful
- may escape as heat

No energy is lost or created

## Conservation of energy

the amount of energy at one location can change, but the total amount of energy stays the same



Chemical bonds

vary in strength

Stronger bond = greater energy  
needed to break it

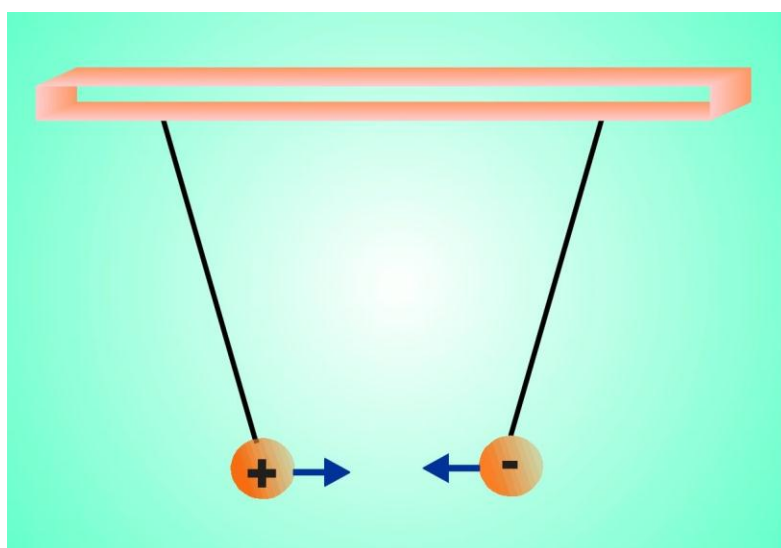
Ion

atom that gains or loses electrons  
(atom with a negative charge)

The atom becomes positively (+)  
or negatively (-) charged



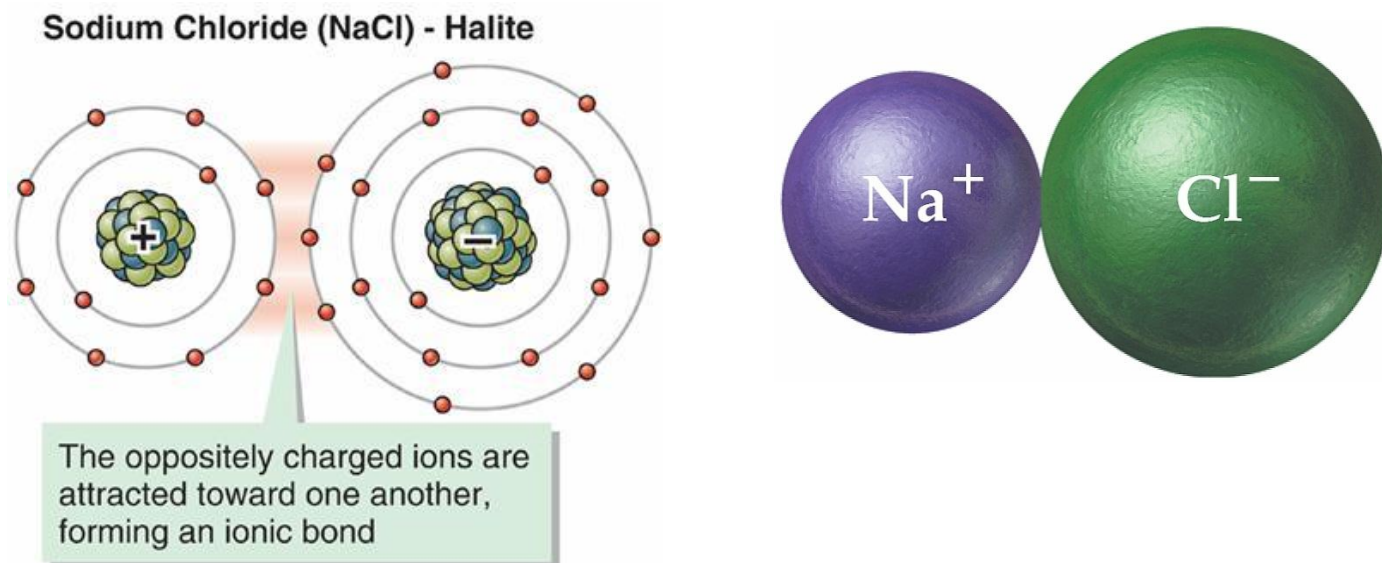
Oppositely charged ions attract  
each other





## Ionic bond

a chemical bond formed by the attraction between oppositely charged ions (salt; NaCl)



<http://www.footprints-science.co.uk/ionic.htm>

[http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic\\_bond\\_in\\_sodium\\_chloride](http://www.middleschoolchemistry.com/multimedia/chapter4/lesson5#ionic_bond_in_sodium_chloride)

[http://www.bbc.co.uk/schools/gcsebitesize/science/add\\_aqa\\_pre\\_2011/atomic/ionicrev4.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/atomic/ionicrev4.shtml)

[http://www.education.uoit.ca/lordec/ID\\_LORDEC/ionic\\_compounds/law\\_ionic\\_compounds.swf](http://www.education.uoit.ca/lordec/ID_LORDEC/ionic_compounds/law_ionic_compounds.swf)

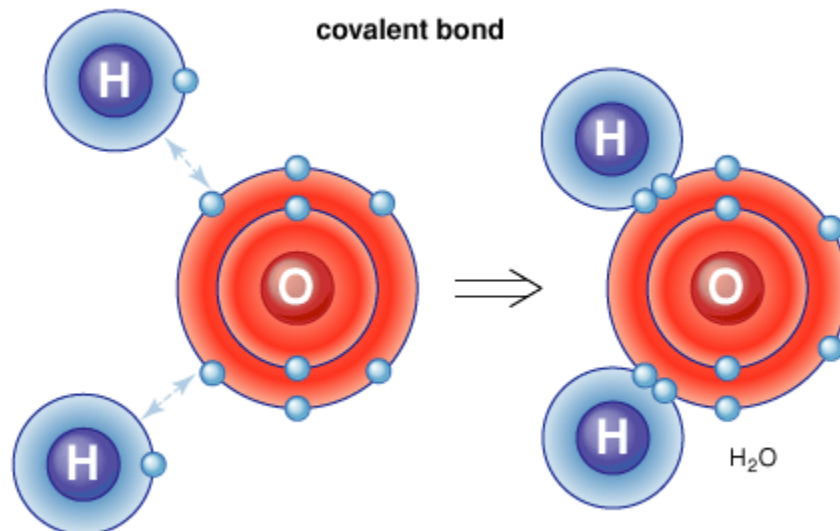
Ionic bonds are weak (salt dissolves in water)

Sharing electrons

makes stronger bonds

## Covalent bond

a chemical bond that forms when two atoms share a pair of electrons (water;  $\text{H}_2\text{O}$ )



<http://bcs.whfreeman.com/thelifewire/content/chp02/02020.html>

[http://www.kentchemistry.com/links/bonding/bondingflash/es/bond\\_types.swf](http://www.kentchemistry.com/links/bonding/bondingflash/es/bond_types.swf)

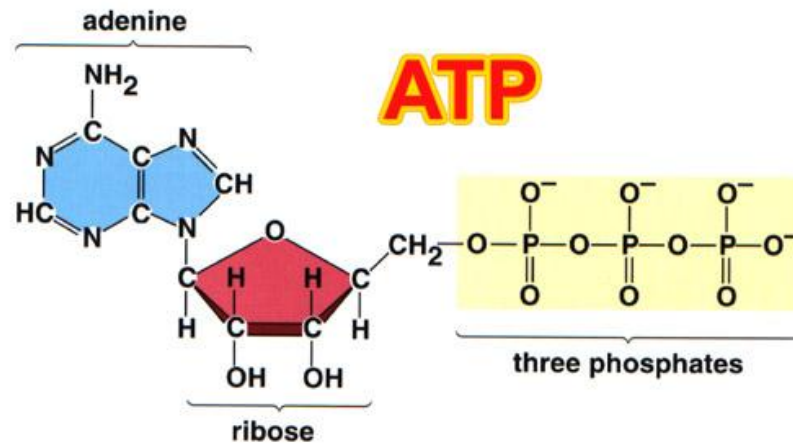
ATP (adenosine)  
triphosphate

an energy carrier that stores or  
releases energy for the cell

Used in organisms as a direct  
source of energy

ATP is a carrier that carries or  
transports energy to other  
molecules in the cell so needed  
chemical reactions can occur

It is the direct source of energy for most cellular work



Cells need energy from ATP

- biosynthesis
- remove waste
- take in nutrients
- move ions in and out of cells
- move from place to place

## Energy in Matter

### Analysis

Date

Page 421Page

1. What is the difference between kinetic energy and potential energy?
2. Why is the energy stored in chemical bonds of a molecule not destroyed when that molecule is broken down to smaller molecules?

